US STEEL
CLAIRTON WORKS

Control Water and Distillation Practices

July 27, 1999

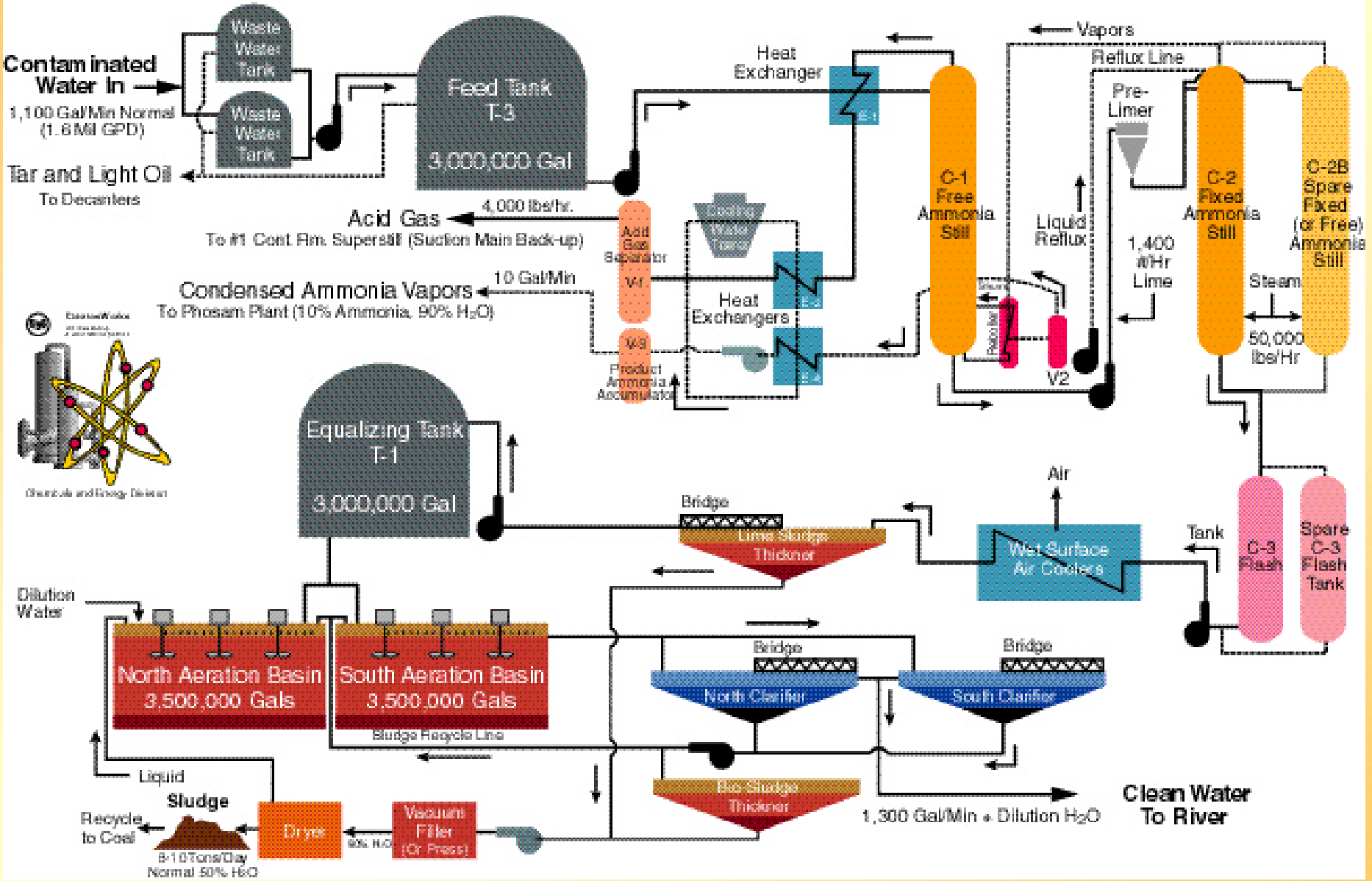
TOPICS

Explanation of the Process

Use of Control Water

Distillation Methods

Clairton Contaminated Water Treatment Plant



~~DILUTION WATER~~

CONTROL WATER

CONTROL WATER
Maintains a Healthy Bio System

- **Year Round Bio Reactor Temperature Control**
- **Conductivity**
- **Biological Reaction (Kinetic) Control**

BIODEGRADATION KINETICS

The rate at which the bacteria degrade the contaminants

Consistent Nitrification

The rate of degradation in the biomass must be higher than the chemical feed rate

The bacteria can’t be fed faster than their digestive process

When the chemical feed rate exceeds the biomass degradation rate

the excess becomes toxic to the bio system

Toxicity Testing

Bioluminescent Marine Bacteria

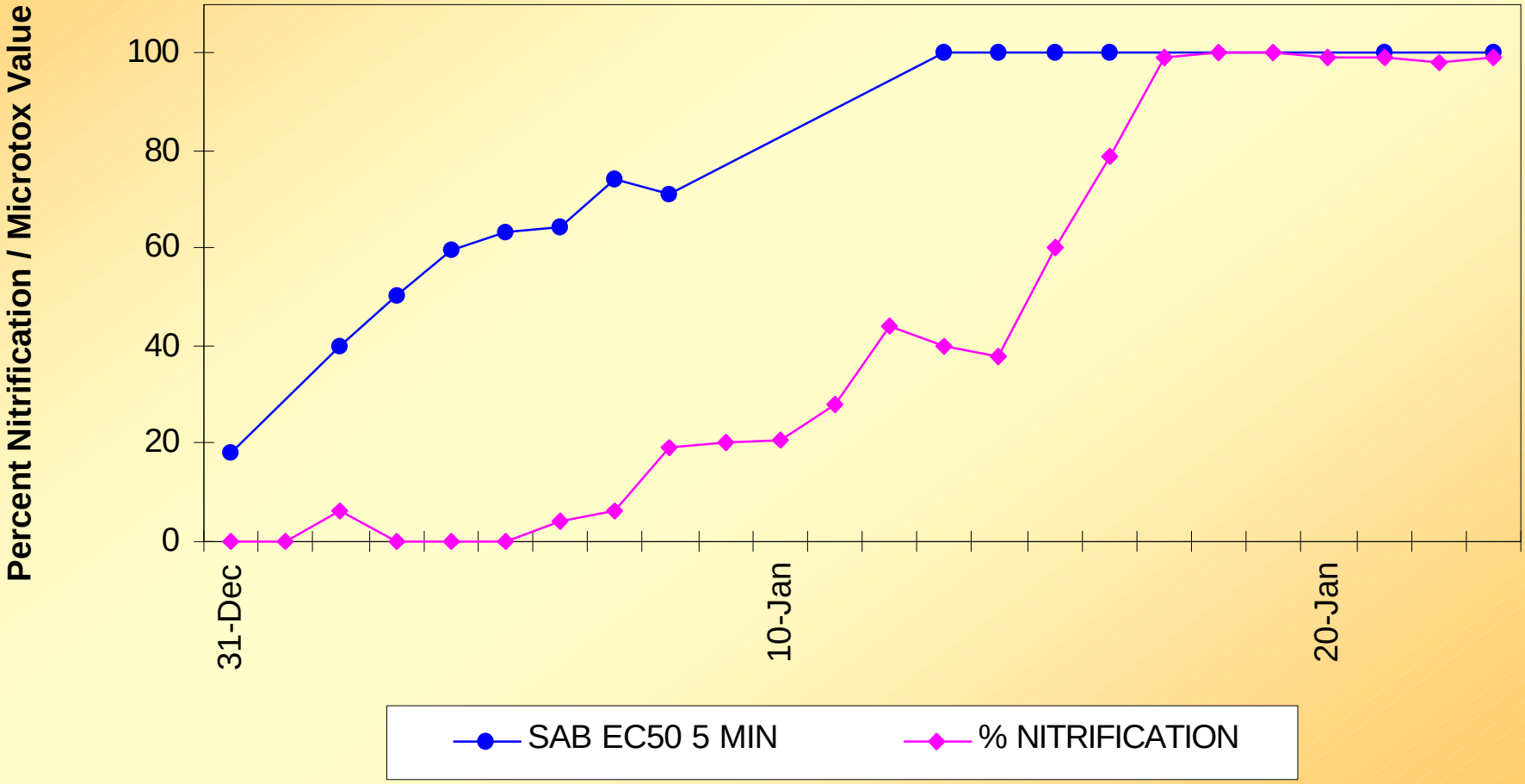
- **Interprets the toxic effect a waste stream will impose on the bio system**
- **Monitors the health of the bacteria**
- **Determines necessary control water ratio**

Control Water Ratio

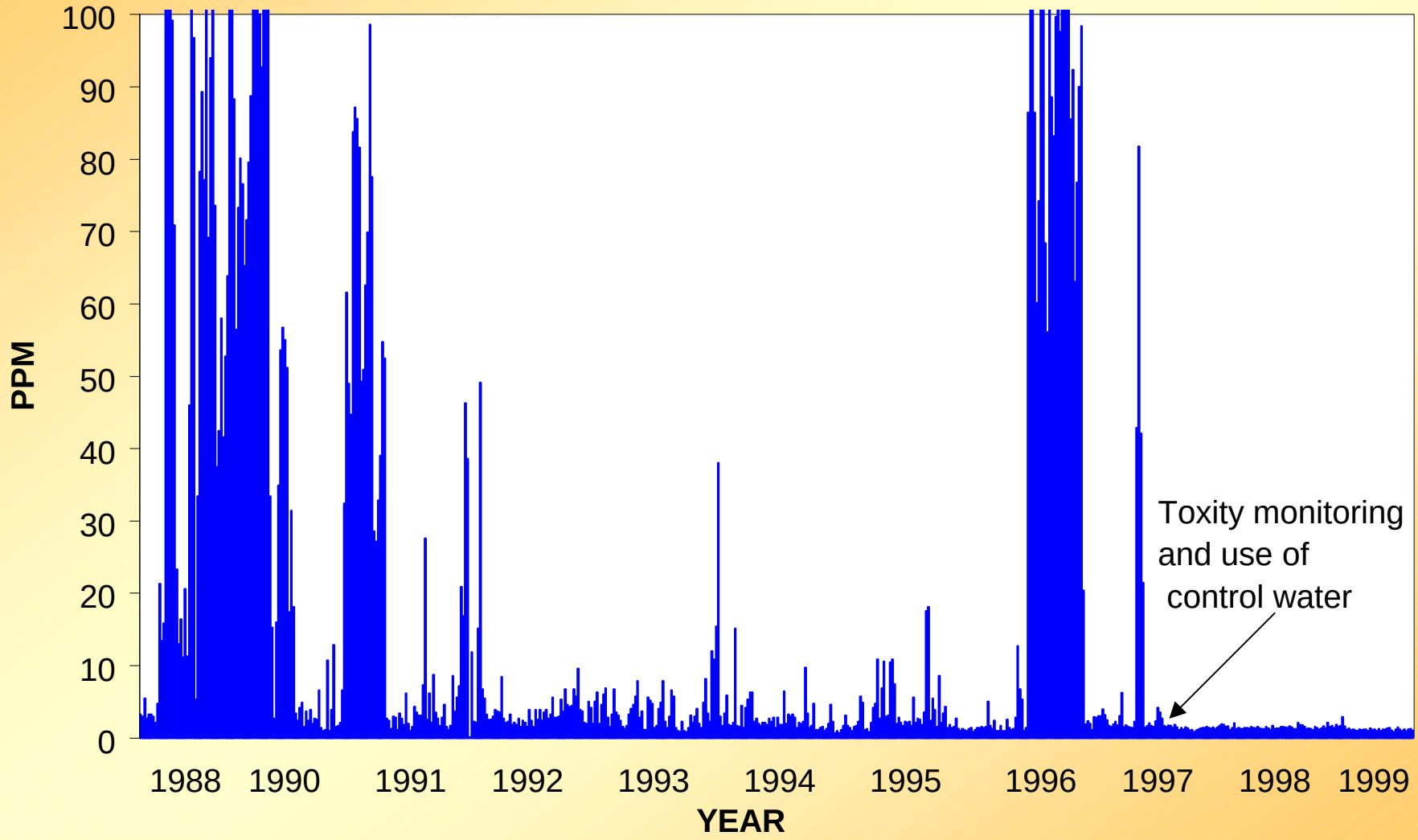
Adjusted to control toxicity levels in order to maintain a degradation rate greater than the rate of contaminated feed

Maintains balance in the bio system

NITRIFICATION/TOXICITY RELATIONSHIP



FINAL EFFLUENT AMMONIA CONCENTRATION



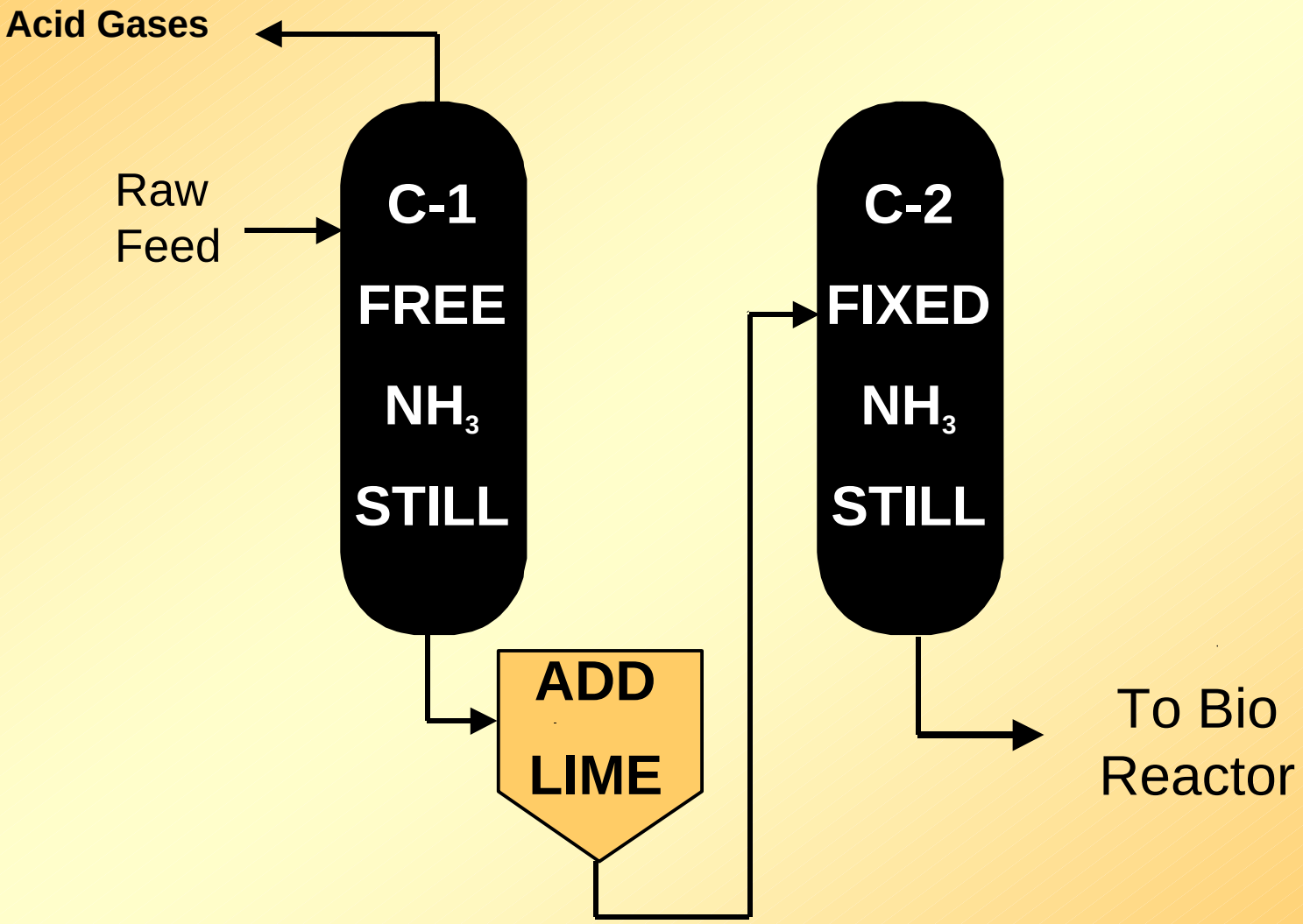
Distillation Methods Comparison

USS Clairton System

2 Stage Distillation

EPA Recommended BAT System

TWO STAGE DISTILLATION



Two Stage Distillation Cyanide Removal

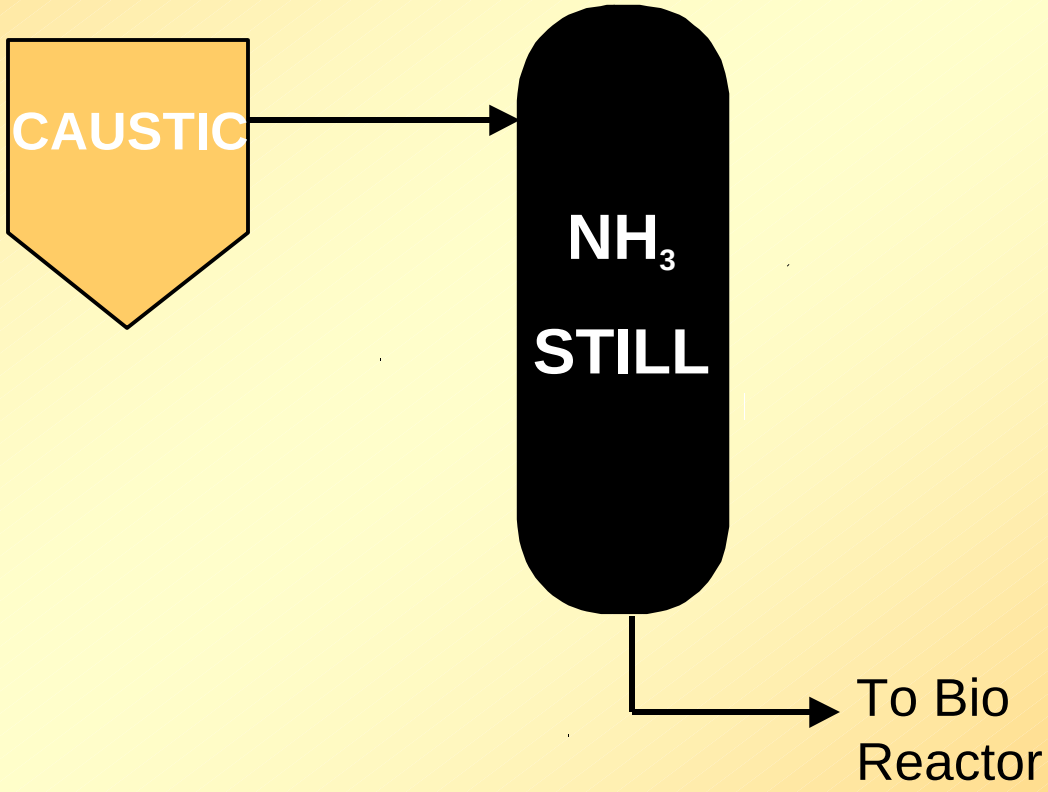
$$\underset{\text{Weak Bond}}{NH_4CN} \xrightarrow[\text{Steam}]{} NH_3 + HCN$$

- **Steam Strippable / Weak Bond**
- **Still Influent 1000 ppm CN**
- **Still Effluent < 5ppm CN**
- **75 lbs/day* CN load to bio system**

  Safe **for bio system**

* **Based on 1.6 MGD flow**

ONE STAGE DISTILLATION



ONE STAGE DISTILLATION CYANIDE REMOVAL

$$NaOH + NH_4CN \longrightarrow NaCN + NH_3 + H_2O$$

$$NaCN \xrightarrow{Steam} NaCN$$

Strong Bond

- **Non-steam strippable/strong bond**
- **Influent 1000ppm CN**
- **Effluent 1000ppm CN**
- **15,000 lbs/day* CN load to bio system - *Fatal* to bio system**

* Based on 1.6 MGD flow

Acid Gas Distillation Comparison

Two Stage

- CN Removed to safe level for bio system
- H_2S Removed to safe level for bio system
- CO_2 Removed for proper still operation

One Stage

- No CN Removal - toxic to bio system
- No H_2S Removal - toxic to bio mass
- No CO_2 Removal - plug still with $CaCO_3$

CONTROL WATER
and
ACID GAS REMOVAL

THIS MODE OF OPERATION IS THE KEY TO CLAIRTON'S EXEMPLARY PERFORMANCE. FAILURE TO USE CONTROL WATER AND/OR REMOVE ACID GASES WOULD PUT THE ENVIRONMENT AT RISK